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Voluntary action for climate change mitigation does not exhibit locational preferences☆

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ABSTRACT

The climate system is indifferent as to the location of voluntary mitigation activities. Are people? Our artifactual online field experiment varies, for residents of a European Union member state, (1) whether the location of a real CO_2 mitigation measure is made salient or not or (2) whether the salient location is in the European Union or in a developing country. Harnessing between- and within-subjects variation in our panel data and controlling for cost effectiveness, we find that subjects respond to the location being made salient. Contrary to previous evidence, however, they are indifferent between mitigation sites. We conclude that locational preferences need not stand in the way of realizing the gains from comparative advantage in climate change mitigation.

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1. Introduction

A widely acknowledged feature of the climate change problem is the fact that the climate system is essentially indifferent as to where on Earth mitigation activities are carried out. From an economic perspective, this source indifference implies that the global division of labor in providing climate change mitigation can be allowed to be determined entirely by countries' comparative advantage in mitigation costs. These costs differ significantly across the globe, offering substantial scope for harnessing the logic of comparative advantage in order to provide the global public good of mitigation provision.[1]

A considerable share of the populations in industrialized countries show a willingness to voluntarily provide climate change mitigation (Aldy et al., 2012; Lindman et al., 2013; Löschel et al., 2013; Diederich and Goeschl, 2014). Would these people

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[1] Empirical estimates put the international differences in marginal abatement costs for CO_2 across the globe up to two orders of magnitude (Beach et al., 2015; Morris et al., 2012; Criqui et al., 1999). This is driven by differences in sectoral composition and gradients in technological efficiency between countries, with relatively cheap mitigation in developing and industrializing and relatively expensive mitigation opportunities in already industrialized countries. The empirical evidence on international trade in emission allowances under the UNFCCC confirms this pattern (Dechezleprêtre et al., 2009).

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want to deviate from the logic of comparative advantage because they have locational preferences over where mitigation activities are carried out? Several possible economic and behavioral reasons for a 'home bias' have been pointed out. First, individuals may prefer mitigation closer to home because they believe that it provides some amount of localized co-benefits to themselves or some group of co-beneficiaries they care about (Bollen et al., 2009; Buchan et al., 2009; West et al., 2013).[2] Secondly, they could believe that problems of compliance and trustworthiness reduce or perhaps even reverse the comparative advantage of developing countries as locations for mitigation.[3] Third, "social discounting" may discourage the transfer of funds for mitigation projects that generate local co-benefits away from groups with which the donor feels greater affinity (Strombach et al., 2014; Jones and Rachlin, 2006). Fourth, offset motives may be prejudiced towards reducing preferably one's own emissions (Kotchen, 2009). Finally, a demonstration effect (Shang and Croson, 2009; Feldstein and Clotfelter, 1976) may signal the own group's perceived leadership in climate policy (Sarasini, 2009). Reasons for preferring mitigation activities to be carried out, everything else equal, in developing countries mainly focus on redistributive motives from a decreasing marginal utility of money for mitigation activities that generate local income effects (Dutschke and Michaelowa, 2006).

Existing empirical evidence on locational preferences for public goods production offers an inconclusive picture, both at the general level and in the particular context of climate policy. Studies of abstract multi-level public good games typically find that under laboratory conditions, subjects exhibit a significant preference for providing local as opposed to global public goods, presumably because a common affiliation to a smaller group reduces social distance (Blackwell and McKee, 2003; Fellner and Lünser, 2014; Chakravarty and Fonseca, 2017). This finding is, however, only partially supported by field evidence (Buchan et al., 2009; Gallier et al., 2017). Studies in the specific context of climate change mitigation are also inconclusive: Torres et al. (2015) conduct a choice experiment in Mexico and find a greater willingness to pay for offset activities located geographically closer to the subject. Closer to our paper are two recent experimental studies: Baranzini et al. (2016) find that a sample of 300 Swiss students allocates a higher share of a previously chosen donation amount for reforestation activities to a program in a developing country than to one in Switzerland.[4] Buntaine and Prather (2018) find in two experiments with 1214 and 2656 subjects, respectively, recruited from Amazon's Mechanical Turk online labor market, that US subjects favor mitigation activities located in the US, but that information about relative costs can alter this choice.[5]

This paper reports on an online experiment in which we offered an (Internet-) representative sample in a European Union member state a dichotomous choice between a randomly assigned cash amount between € 2 and € 100 and the verified mitigation of exactly one metric ton of CO_2 emissions. The core result comes from comparing the choices of 1585 subjects in two location treatments. One treatment (EU) emphasized that the verified mitigation would be carried out within the European Union, from where the subject's own emissions originate, while the other treatment (DC) realized the same emissions reduction in a developing country, with local social and environmental co-benefits. For a consecutive second choice, the location of the mitigation activity was switched and another cash amount randomly drawn. On this basis, we can compare choices given an explicit uniform climate impact (one ton) and given independent exogenous random variation in relative cost effectiveness, observing both between- and within-subject variation. Also, we can compare these choices to those of 2355 subjects that take the same decision in a treatment (NE) in which the EU location of mitigation is introduced in more neutral language and not made salient.

In result, we find that, controlling for cost effectiveness, our subjects' decisions do not exhibit significant locational preferences between mitigation sites. For the NE treatment, we find that a more neutral framing on average made subjects about three to four percent less likely to choose mitigation over the cash prize. Failing to observe locational preferences is therefore not driven by a lack of salience. We interpret this finding as evidence that locational preferences need not stand in the way of realizing the gains from comparative advantage in climate change mitigation.

The next section describes the experimental design and subject sample. Section 3 then presents the results, which we discuss in section 4. Section 5 concludes.

2. Experimental protocol

Our simple experiment involved two consecutive binary choices between receiving a cash award and providing an actual carbon emissions reduction. For each subject and choice, the amount of the cash award was a random, even-numbered draw in the range of € 2 to € 100. The carbon emissions reduction always amounted to one ton of carbon dioxide and was facilitated by purchasing and deleting either one EU emissions allowance (EUA) under the EU Emissions Trading Scheme (in the

[2] Reduction in greenhouse gas emissions typically target the fossil energy sector that is also responsible for the emission of other pollutants such as sulfur oxides and nitrous oxides.

[3] People may believe that mitigation projects in developing countries have little additionality (Hayashi and Michaelowa, 2013) or suffer from fraud (Lovell, 2010; Gillenwater et al., 2007).

[4] Note that by design, the foreign project yields three times as much mitigation per unit of endowment. Moreover, in an informational treatment that further emphasizes the productivity differences, the foreign project receives even higher shares while an emphasis either on local co-benefits or trustworthiness fails to differ from the baseline.

[5] Providing subjects with ordinal information about relative cost effectiveness neutralizes the preference for domestic abatement in the first experiment and reverses it in the second one. In contrast, a treatment informing about local co-benefits strengthens the preference for domestic programs.

Table 1
Two-stages counterfactual design of treatments.

Choice	Experimental group		
	1	2	3
1	EU	DC	NE
2	DC	EU	other
# of subjects	788	797	2355

EU and NE treatments) or one "Gold Standard" Certified Emissions Reduction (CER) based on the Clean Development Mechanism of the Kyoto Protocol (in the DC treatment). Subjects were randomly assigned to one of three experimental groups which determined the sequence of treatments they faced (Table 1).[6] The partial counter-factual design allows us to analyze between-subjects differences between independent first choices as well as within-subject variation in experimental groups 1 and 2.

Each choice was presented and elicited on two consecutive computer screens. The first screen introduced the choice framed as selecting the prize for a lottery in which winners' choices would be implemented, included a succinct explanation of how deleting either an EUA or Gold Standard CER would result in a real and reliable reduction in CO_2 emissions, and advised subjects on the pure public good character of providing an emissions reduction. Treatments differed in how the choice options were presented. While in the EU treatment, instructions emphasized that emission cuts would take place "within the European Union" and hence, would concern "domestic emissions […] to which your personal energy use contributes", in the DC treatment, the text stated that emission cuts would be achieved by an "emission reduction project in a developing country" that would guarantee social and environmental co-benefits for the local population. In contrast, the NE treatment did not include any of these additional wordings.[7] All instructions were kept short and simple and refrained from giving extensive background information about climate change.[8] The second screen described how each option, if chosen, would be implemented in the experiment and elicited the choice by presenting checkboxes with the subject-specific amount of the cash award and the full name of the emission reduction option in random order.[9]

The Internet experiment ran in two sessions in May and July 2010 over the course of 15 days in total. We used the infrastructure of a large Internet polling company (YouGov) to recruit and pay an Internet-representative[10] subject sample of 4079 voting-aged Germans and to administer the experiment on their survey platform. Participants faced a sequence of 10–14 computer screens, depending on their decisions, that included an introductory screen, a filter screen to focus on German subjects, the four screens of the two consecutive prize choices, and follow-up questions on climate change mitigation, carbon certificates, and sociodemographic characteristics. Prior to the experiment, a set of pre-tests and a pilot experiment with 200 economics students at Heidelberg University were run to test and refine the online implementation and the wording of the instructions.

3. Results

A sample of 3940 subjects completed the experiment with a median completion time of five minutes.[11]

Table 2 presents descriptive results on the choice of the emissions reduction in each choice and treatment. Comparing independent first choices, we observe that the shares in favor of the emission reduction are virtually the same at about 20% in both the EU and DC treatments, with no statistically significant difference. Being offered a second choice increases the propensity to choose the reduction in both treatments, however, the increase is about 3.7 percentage points higher if offered a CER instead of an EUA. The resulting marginally significant difference in second choices is, however, not independent from what subjects saw in their first choice.

In order to control for differences in experimental price, repetition of the choice, and other potential covariates, Table 3 presents regression results. Column (1) confirms the previous observation of no significant between-subjects differences

[6] In group 3, subjects faced the NE treatment in their first choice and were administered one of three unrelated other treatments in their second choice. Therefore, about three times as many subjects as in group 1 or 2 were assigned to this group.

[7] See the online supplementary material for full translations of the screens in English.

[8] Researchers have taken opposing stands as to the extent to which information should be provided about an unfamiliar good that is to be valued or for which demand is to be revealed by study participants. While the best practice in contingent valuation generally calls for providing respondents with extensive information, it has also been argued against giving potentially choice-relevant information around the time of the contribution decision (Arrow et al., 1993). In our case, we expected our participants to overwhelmingly accept the empirical veracity of climate change and its anthropogenic cause in the form of greenhouse gas emissions based on prior survey evidence for German citizens (European Commission, 2008). In this respect, we expect that describing only a few key items that differed between treatments when describing the choice would, if any, introduce a bias *in favor* of finding differences between treatments.

[9] Subjects that chose the cash award would have the value credited to their personal account at the polling company while those who chose the emissions reductions could verify that the emissions reduction had been carried out through certification presented on a university website.

[10] The sample was Internet-representative with respect to age, gender, and region of residence.

[11] Mean completion time was 80 min. The difference between mean and median is largely driven by outliers who availed themselves of the opportunity to leave the survey and continue hours or days later. Responses to the follow-up questions revealed 139 subjects who either objected to emission certificates as a proper method to reduce emissions or said they distrusted the experiment. These subjects are excluded from the analysis.

Table 2
Fraction of choices of emissions reduction.

Choice	Experimental group			EU vs. DC	NE vs. EU	NE vs. DC
	1 EU-DC	2 DC-EU	3 NE-other			
1	20.1% EUA	19.4% CER	16.2% EUA	$p = 0.76$	$p = 0.01$	$p = 0.04$
2	30.1% CER	25.7% EUA	–	$p = 0.05$	–	–

Notes: p-values report two-sample Wilcoxon rank-sum tests on the distribution of choices.

Table 3
Regression results.

	EU vs. DC (Base: EU)			NE, EU, DC (Base: NE)
	1st choices only(1)	Panel(2)	Panel(3)	1st choices Only(4)
EU	–	–	–	0.289**
				(0.122)
DC	−0.040	0.123	0.150	0.230*
	(0.150)	(0.151)	(0.154)	(0.125)
Price	−0.002	−0.019***	−0.020***	−0.005***
	(0.003)	(0.004)	(0.004)	(0.002)
2nd choice	–	0.870***	0.974***	–
		(0.152)	(0.163)	
Time-loc. FE	Yes	–	Yes	Yes
Sociodem. ctrls.	Yes	–	Yes	Yes
Indiv. FE	–	Yes	–	–
Constant	−3.477***	–	−5.593***	−3.208***
	(0.711)		(1.319)	(0.449)
N	1228	522	2460	3103
Log-likelihood	−577.072	−133.547	−1123.807	−1376.526
χ^2	61.983	94.729	107.264	124.757
Pseudo R^2	0.051	0.262		0.043

Notes: Logistic regressions of the choice (1 if emissions reduction). Column (2) is a conditional fixed-effects, column (3) a random-effects panel model. "Time-location fixed effects" include indicator variables for region (Bundesland), day, and daytime (morning, afternoon, evening, or night) of choices. "Sociodemographic controls" include age, gender, years of education, income, and number of children in household. Standard errors are shown in parentheses.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

for choice 1 between the two treatments.[12] Our preferred specification is the within-subject comparison reported in column (2), which exploits both choices of each subject. It includes subject fixed-effects that account for all observed and unobserved individual heterogeneity. A drawback of model (2) is that only 261 subjects switch their decision between choice rounds. We therefore additionally report a random-effects model in column (3) that includes individual controls. In both models, price and repetition become highly significant determinants of the choice, with signs as expected, while the treatment variable remains insignificant ($p = 0.41$ and $p = 0.79$, respectively). We interpret this as evidence that any difference between the EU and DC treatments regarding the propensity to choose the emissions reduction is negligible.[13]

Tests reported in Table 2 also suggest that the propensity to choose the emissions reduction in first choices in the more salient EU and DC treatments significantly exceed that in the more neutral NE treatment, by about four and three percentage points, respectively. Regressions confirm this finding. Column (4) of Table 3 estimates a model corresponding to column (1) but with the NE treatment as the baseline. We observe significantly higher coefficient estimates for the EU and DC treatments that translate into average marginal effects of 4.1 and 3.2 percentage points in probabilities ($p = 0.02$ and $p = 0.08$, respectively).[14]

[12] N differs from the full size of the joint EU and DC treatments (1585 subjects or 3170 choices) in columns (1) and (3) due to some missing answers in the follow-up questionnaire on sociodemographics.

[13] We test the robustness of these logistic regression results using linear probability and probit models. Results are identical, with the exception of the fixed-effects linear probability model corresponding to column (2), which estimates an about 2% higher propensity to choose the reduction if the CER is offered at a weak significance level ($p = 0.08$). We also test for interactions with the experimental price but never find a significant change of the treatment effect with price.

[14] We obtain identical significance levels and comparable marginal effects when using a probit or linear probability model instead of the logit in column (4). Relaxing the assumption of a uniform price effect across treatments suggests that one obtains largest differences between treatments for high prices, since the propensity to choose the reduction significantly decreases in the price in the NE treatment but much weaker so in the other treatments, particularly in the EU treatment (results available upon request).

4. Discussion

Our core result is that our industrialized-country subjects are locationally indifferent between funding climate change mitigation activities in their own region and in a foreign developing country. Our experiment therefore finds little evidence for a "pure" preference for location in providing this global public good. Instead, the significant price effects in our data are in line with evidence in Baranzini et al. (2016) and Buntaine and Prather (2018) that locational preferences may be driven by perceptions of relative productivity. Such price effects point to problems inherent in a design with fixed relative productivity as in Baranzini et al. (2016) or with only qualitative variation as in Buntaine and Prather (2018) that cannot isolate "pure" locational preferences since subjects are never offered the same amount of verified mitigation for the same price in two different locations. Isolating such preferences in the presence of price effects requires a design choice like the one presented here, which actively controls for cost-effectiveness and uses a uniform and specific amount of global public good.[15]

In interpreting our results, one should keep in mind that our design has the potential to prime subjects regarding certain motivations for locational preferences known from the literature while minimizing others. First, instructions emphasized local co-benefits of Gold Standard CERs for the population in the developing country and minimized concerns about compliance or lack of additionality of the supported project. For EUAs, instructions may have primed regarding offset motives. In all treatments, instructions did not explicitly prime for social identity or demonstration effects. Finally, instructions corrected any erroneous beliefs about whether there exist local direct benefits of CO_2 reductions. Hence, we interpret our measure of locational preferences as conditional on correct beliefs about carbon mitigation being a global pure public good.

Comparing the core result with the findings by Baranzini et al. (2016) and Buntaine and Prather (2018), other factors are also likely to play a role. One is that our subject pool differs with respect to nationality (German vs. Swiss vs. US citizens) and representativeness (Internet-representativeness vs. students vs. Amazon Mechanical Turk workers). Another is that our single-bounded dichotomous choice tasks emphasize the extensive margin of subjects' decisions.

Finally, comparing our result with the typical findings of abstract multi-level public good experiments, the present evidence is in line with field evidence (Gallier et al., 2017; Buchan et al., 2009) that struggles to recover the local bias effect familiar from laboratory settings. This field evience is particularly strong in settings such as ours, where the degree of globalization in the subjects' economy is high (Buchan et al., 2009).

5. Conclusion

In a climate system that is indifferent about where mitigation is carried out, the logic of comparative advantages favors abatement locations in developing and rapidly industrializing countries. There is evidence, however, that citizens of industrialized countries who voluntarily fund climate mitigation activities are not indifferent about the mitigation location. In our artifactual online experiment, subjects located in a European Union member state took a dichotomous choice between a cash prize and the verified mitigation of one metric ton of CO_2. Treatment conditions varied the location of the mitigation activity between the European Union and a developing country as well as the salience of the location. We find that, everything else equal, the probability that the mitigation activity is chosen is not affected by locational preferences. This result holds both in a between-subjects and a within-subjects analysis. Also, we find that being more explicit about the location of where a subject's voluntary mitigation activities will be carried out made the average subject more likely to choose mitigation over the cash prize. Failing to observe locational preferences is therefore not driven by a lack of salience. Given our experimental control over the cost of mitigation for the individual, the verified uniformity of mitigation activities across EU and developing country sites, and the Internet-representative nature of our sample, we interpret this finding as evidence that for the population at hand, locational preferences need not stand in the way of realizing the gains from comparative advantage in climate change mitigation.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jeem.2018.03.006.

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[15] A conceivable complication of holding cost effectiveness the same across locations could be subjects' awareness of true cost differentials outside the experiment, leading to field price censoring. However, subjects were unaware of the field price of mitigation activities both in general (Diederich and Goeschl, 2017) and in a locations-specific context (Buntaine and Prather, 2018; Baranzini et al., 2016). Diederich and Goeschl (2017) apply a battery of tests to detect field price censoring using the same subject pool and design and find no evidence.

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